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February 24, 2011

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The Honorable Adam Smith  
Ranking Member  
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House of Representatives

Subject: *Tactical Aircraft: Air Force Fighter Reports Generally Addressed Congressional Mandates, but Reflected Dated Plans and Guidance, and Limited Analyses*

The Air Force expects to invest over \$230 billion to operate, maintain, modernize, and recapitalize its tactical air forces during fiscal years 2011 through 2015.<sup>1</sup> This makes up nearly 70 percent of the Department of Defense's (DOD) total expected tactical aircraft investment over that time. Despite this large investment, the Air Force continues to project that its inventory of fighter and attack aircraft will drop below required levels and that those shortfalls will persist through at least 2030. However, the timing and magnitude of projected shortfalls continue to fluctuate. In April 2008, senior Air Force leaders testified before Congress that they expected the Air Force fighter shortfall to peak at about 800 aircraft in the mid-2020s. Since that time the Air Force has reduced its overall requirement and adjusted its assumptions about Joint Strike Fighter (JSF) procurement and the viability of legacy aircraft. As a result, the Air Force now expects its shortfall to peak at about 200 aircraft. Still, this poses a challenge as the Air Force must effectively balance its investments between the JSF

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<sup>1</sup> The Air Force's tactical aircraft investment cited here reflects projected funding for research, development, test and evaluation, procurement, operations and maintenance, military construction, and military personnel specifically tied to tactical aircraft in DOD's 2011 Future Years Defense Program. Tactical aircraft are fixed-wing fighters and ground attack/strike aircraft.

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program and efforts to keep legacy aircraft viable for longer periods than originally planned.<sup>2</sup>

In 2009, Congress directed the Air Force to provide three reports addressing the service's fighter force structure plans in light of its projected fighter aircraft shortfall.<sup>3</sup> One report was to detail the Air Force's rationale for retiring about 250 aircraft in light of the pending shortfall, while the other two reports were to address alternative investment options for mitigating the shortfall, including the interim procurement of new so-called "4.5 generation" fighter aircraft, and upgrades and service life extension programs for current legacy aircraft. Congress defined new 4.5 generation fighter aircraft as including F-15, F-16, and F-18 aircraft that have advanced radar, data-link, and avionics capabilities and the capability to deploy advanced armaments. The Air Force delivered the first report in January 2010 and the last two in April 2010.<sup>4</sup> In general, the Air Force concluded that:

- It could reduce its total fighter and attack aircraft inventory by about 250 aircraft and still effectively perform its missions with slightly increased risk;
- Effective management of the JSF program coupled with investments in modernizing and upgrading legacy F-16 aircraft would mitigate the projected shortfall;
- Procuring 4.5 generation aircraft to mitigate the projected shortfall would not support the Air Force's overall fleet modernization plans for an all-stealth future fighter force and therefore is not supported;
- Extending the service life and upgrading current fighters would be 10 to 15 percent of the cost of procuring new upgraded legacy aircraft and provide essentially the same capability; and
- The Air Force would still be able to perform its homeland defense mission.

The Ike Skelton National Defense Authorization Act (NDAA) for Fiscal Year 2011 directed GAO to evaluate the sufficiency, adequacy, and conclusions in the three Air Force reports.<sup>5</sup> In response, this report assesses (1) whether the Air Force reports addressed the topics and issues required by Congress, (2) the currency and relevance of service plans and strategic level guidance that informed the Air Force's conclusions, and (3) the robustness of the data and analyses underpinning those conclusions. Therefore, we reviewed the Air Force reports for their sufficiency with the reporting requirements established in the respective congressional mandates. To

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<sup>2</sup> The Air Force's legacy fighter and attack fleet is made up of F-16s, F-15s, and A-10s, many of which were purchased in the 1970s and 1980s.

<sup>3</sup> The Air Force reporting requirements were contained in the following: (1) H.R. Rep. No. 111-166, at 101 (2009); (2) the National Defense Authorization Act (NDAA) for Fiscal Year 2010, Pub. L. No. 111-84 (NDAA for Fiscal Year 2010) § 131 (2009); and (3) H.R. Conf. Rep. No. 111-288, at 290-291 and 814 (2009), which is the same requirement contained in NDAA for Fiscal Year 2010 §1075.

<sup>4</sup> *Combat Air Forces Restructuring* (Jan. 2010), *Fighter Force Structure Shortfalls* (April 2010), and *Procurement of "4.5 Generation Fighter" Aircraft* (April 2010). The reports are classified.

<sup>5</sup> Pub. L. No. 111-383 § 1053.

assess the analyses, data, and assumptions underpinning the conclusions we conducted detailed interviews with DOD and Air Force officials that were responsible for performing the analyses, and the officials responsible for writing the reports. During those interviews we discussed the dates and sources of key data and assumptions underpinning the Air Force's analyses, and reviewed the analytical tools and methods used to conduct those analyses. We also examined the Air Force's ongoing efforts to address structural deficiencies in legacy F-16s through the Falcon Structural Augmentation Roadmap (Falcon STAR)<sup>6</sup> program, and drew extensively on our July 2010 report examining DOD's tactical aircraft requirements, force structure, and investment plans.<sup>7</sup>

We conducted this performance audit from August 2010 to March 2011 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit and obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

## Summary

While the three Air Force fighter reports generally covered the topics and issues identified by Congress, the conclusions reflected previously established service plans and strategic level guidance that was dated by the time the reports were issued. In addition, the robustness of the analyses done to support the conclusions in the reports was limited by JSF program instability and the absence of F-16 durability and fleet viability data. The reports presented limited new analyses and primarily summarized the Air Force's long-standing plan to transition to an all-stealth 5th generation fighter force and the desire therefore to avoid large investments in legacy, non-stealth fighters that could divert funds from this plan. Analyses underpinning shortfall projections and future force requirements were based on strategic level guidance, threat scenarios, and force planning constructs that had changed by the time the three reports were issued. The Air Force's conclusions were also dependent on assumptions about JSF program performance and the feasibility of extending the life of legacy F-16s beyond 8,000 hours, but key data were either in flux or were not available when the reports were prepared. Since then, JSF costs significantly increased and its schedule slipped; important data regarding the feasibility and cost of extending the F-16's service life are still not available. Air Force officials acknowledge that many things have changed since their analyses were completed, but note that they used the best data available to them at the time and, based on more recent analyses, they are confident that 5th generation aircraft will continue to be

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<sup>6</sup> Falcon STAR (Structural Augmentation Roadmap) is an F-16 upgrade program that was initiated in 2003 to replace or rework various aircraft structural components to preclude the onset of widespread fatigue damage, maintain safety of flight, enhance aircraft availability, and allow the F-16s to achieve their full 8,000 flight hour service lives.

<sup>7</sup> GAO, *Tactical Aircraft: DOD's Ability to Meet Future Requirements Is Uncertain, with Key Analyses Needed to Inform Upcoming Investment Decisions*, GAO-10-789 (Washington, D.C.: July 29, 2010).

essential to the Air Force's future success. As a result, they do not expect there to be any major changes to Air Force fighter recapitalization plans and thus believe that the basic conclusions in the three force structure reports remain valid. However, better information on the JSF restructured program and on the F-16 fleet is expected to become available in 2011; this could enable a more informed analysis, comparing and contrasting the various alternatives for mitigating the projected aircraft shortfalls.

### **Air Force Reports Generally Addressed the Topics and Issues Required by Congress**

Our comparison of the contents of the three reports with the related direction provided in the relevant statute and House reports found that the three Air Force reports generally addressed the established congressional reporting requirements, including the specific issues and topics identified by Congress. For example, in the report specifically examining the potential procurement of new upgraded legacy fighters—namely *Procurement of 4.5 Generation Fighter Aircraft*—the Air Force discussed its analysis of both multiyear and single-year procurement costs for various quantities of new upgraded aircraft, as directed by Congress in the 2010 National Defense Authorization Act. The Air Force's report on the projected fighter force structure shortfall discusses various strengths and weaknesses related to specific options that Congress had identified for addressing the shortfall, including procurement of new upgraded legacy aircraft and service life extension of current legacy aircraft. Likewise, the report on the Air Force's combat air force restructuring proposal included information about the various topics Congress had identified, including an explanation of the current threat environment and current capabilities as well as the criteria used for selecting the affected bases and the particular fighters that were chosen for retirement. The report also explained that the Air Force's proposal to accelerate the retirement of about 250 aircraft was primarily in response to guidance from the Office of the Secretary of Defense (OSD) that directed the services to eliminate excess force structure capability and increase risk, if necessary, to free up funding for other priorities.

### **Air Force Reports Reflected Previously Established Service Plans and Dated Strategic Level Guidance**

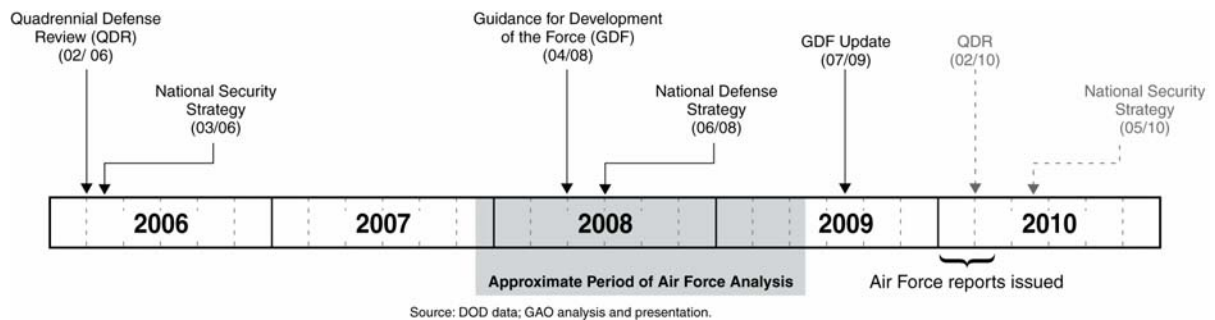
For many years, defense threat assessments and capability analyses have led the Air Force to believe that 5th generation capabilities, including stealth characteristics, fused sensor data, and advanced radars, will be essential to counter the increasingly sophisticated air defense systems of potential future adversaries. Therefore, the Air Force's recapitalization plans have focused almost all funding and priority on replacing legacy fighter aircraft with 5th generation F-22As and JSFs. In December 2005, OSD added \$1 billion to the F-22A program to extend production for 2 years to ensure a 5th generation fighter aircraft production line would remain in operation in case the JSF experienced delays or problems. However, OSD later chose to end procurement of the F-22A in 2010, leaving the Air Force to rely exclusively on the JSF to complete its recapitalization plans.

The Air Force's overarching force management approach requires that all of the aircraft in the service's inventory, including Air National Guard and Air Force Reserve aircraft, be capable of integrating with each other. Air Force officials note that this force management concept does not support having "niche" legacy forces that are dedicated to specific missions that do not require stealth capability, such as homeland defense, and are incapable of participating in more difficult anti-access scenarios. Therefore, the Air Force believes that all future fighter and attack aircraft have to be capable of operating in both anti-access and uncontested airspace.

The Air Force acknowledges that various alternatives, such as purchasing new upgraded legacy aircraft or modernizing existing aircraft, could mitigate some of the projected force structure shortfall. However, the reports emphasize that none of the alternatives, apart from those related to the JSF, would provide the 5th generation capabilities that the Air Force believes are needed. Officials noted that the Air Force views alternatives that would reduce JSF funding or quantities as unacceptable, particularly in light of the expectation that future defense budgets will be limited. Service officials note that the Air Force had already determined that it did not need any new legacy aircraft before the congressional mandates were issued. They emphasized that buying new upgraded legacy aircraft was determined to be undesirable because the Air Force believed that the upfront acquisition cost would negatively impact JSF procurement funding, current legacy aircraft could be upgraded to provide essentially the same capabilities at lower estimated cost, and new upgraded legacy aircraft would not be supportable or effective over the long term.

The analyses supporting the Air Force's conclusions reflected strategic level threat scenarios and force planning constructs that were dated by the time the reports were issued. According to Air Force officials, the service recognized that it was facing a force structure shortfall and began to assess options for addressing it well before the congressional reporting mandates were issued in 2009. The Air Force viewed the reports as a historical look at the analyses that had already been completed to develop its aircraft recapitalization plans and support its fiscal year 2010 budget request. Most of the underlying analyses were conducted in 2007 and 2008 and thus reflected the assumptions and force planning construct in place at that time. That construct largely focused on fighting and winning two nearly simultaneous major combat operations against adversaries possessing high-end, anti-access air defense capabilities. Figure 1 provides a time line comparing the dates of strategic level force planning documents, including the National Security Strategy and the Quadrennial Defense Review (QDR), with the timing of the Air Force's 2010 budget analysis and the issuance of the three fighter force structure reports. As indicated by the gray bar in the figure, the majority of the Air Force's analysis was conducted before the 2010 National Security Strategy and the 2010 QDR were finalized.

**Figure 1: Time Line of Force Planning Guidance and Air Force Analysis**



The Air Force made its force structure and budget decisions using computer models to identify the “best force”—one that would meet operational requirements within expected budget constraints.<sup>8</sup> The primary model is intended to optimize investments across the Air Force portfolio while addressing OSD’s strategic guidance and war fighting scenarios. At the time the Air Force analyses were performed, the guidance and scenarios called for the military services to fight and win two nearly simultaneous major combat operations against adversaries possessing advanced, high-end capabilities. Air Force officials note that they intentionally excluded certain types of systems when they ran their computer models to formulate their 2010 budget. They emphasized that in some cases this had to be done because those systems had been identified as high-priority items, but they would not be recognized by the computer models as having adequate capabilities to address the high-end threat scenarios. Unmanned aircraft were among those systems. In the end, the Air Force reaffirmed its plans to acquire all 5th generation fighter aircraft.

Since the Air Force’s analyses were completed, DOD’s view of future national security challenges has changed, which could impact tactical fighter requirements and the mix of capabilities needed. Although affirming the force planning constructs for the near term, the 2010 QDR signaled a change in force planning by noting that “U.S. forces today and in the years to come can be plausibly challenged by a range of threats that extend far beyond the familiar ‘major regional conflicts’ that have dominated U.S. planning since the end of the Cold War.” The QDR conveys DOD’s assessment of the force structure and capabilities needed to meet many types of demands by presenting three scenario combinations that reflect both current and projected security environments. According to DOD officials, this provides a more realistic picture of the future, but makes quantifying long-term requirements difficult. In addition to evolving security requirements, DOD’s emerging plans for acquiring long range strike capabilities could also impact future fighter requirements.

The Air Force is still in the process of updating its analyses and tactical aircraft requirements to address the new QDR guidance and assumptions. Air Force officials

<sup>8</sup> The Air Force’s primary model is known as the Combat Forces Assessment Model (CFAM), and is used to identify the optimal mix of fighters, bombers, tankers, and other assets for addressing the established scenarios within projected resource constraints. CFAM can also be run to simply identify the overall optimal force mix if resources were not constrained.

agree that much has changed since the reports were prepared but are confident that the changes will not obviate the need for 5th generation aircraft. In fact, they believe that 5th generation aircraft might actually be needed sooner than previously projected. However, while the F-22A and the JSF possess 5th generation characteristics, the use of these assets may be limited by the other factors during the early stages of a conflict, particularly if access to foreign air bases is restricted, flights over neutral countries are restricted, and the Navy's carrier-based forces are pushed further from the enemy's shore for protection.

### **Data and Analyses Supporting the Air Force Reports Were Limited**

The Air Force's data and assumptions relating to the JSF program did not fully reflect the restructured program. Instead, the analyses supporting the three fighter reports incorporated cost and schedule estimates for the JSF that supported the fiscal year 2010 budget. Since the analyses were conducted, worsening JSF program outcomes have resulted in a major restructuring announced in February 2010 and, in June 2010, the department officially certified the JSF program after a critical breach of unit cost baselines. JSF restructuring decisions and actions are not yet complete. Most recently the Secretary of Defense directed a reduction in near-term JSF procurement quantities which slows down the pace of aircraft deliveries. A fully updated JSF baseline is expected to be finalized in 2011. Once the new baseline is available the Air Force will then have the critical data it needs to make better-informed aircraft investment decisions.

Continuing JSF program setbacks in costs, deliveries, and performance directly affect the Air Force's overall modernization plans, legacy fighter fleet management and retirement schedules, and the relative attractiveness of alternative options to mitigate shortfalls. Without a valid updated JSF program baseline, the Air Force's ability to accurately plan for and invest in its fighter fleet is limited, in large part because there is little assurance that the JSF will deliver sufficient quantities of capable aircraft to mitigate the fighter gap and support a moderate risk fighter force structure. At the time the reports were issued, Air Force plans assumed that JSF procurement will peak at 80 aircraft per year. The reports note that achieving this peak JSF production rate is necessary for mitigating the Air Force's projected shortfall.

In addition, key F-16 data were not available to inform the Air Force analyses. The Air Force concluded that small investments in older F-16s, and extending the service lives and enhancing the capability of approximately 300 newer F-16s would help mitigate the projected shortfall through 2030. Air Force officials noted that the proposed service life extension would allow its newer F-16s to remain in service for 2,000 additional hours beyond their expected service life of 8,000 hours. The Air Force's conclusions were not supported by a detailed cost-benefit analysis but instead reflected rough order of magnitude estimates that were done before key data about the feasibility and cost of the proposed efforts were available. The Air Force's Falcon STAR program that focused on addressing various structural deficiencies in legacy F-16 aircraft to allow those aircraft to achieve 8,000 flight hours was still ongoing at the time of the Air Force's analysis. The Falcon STAR program began in



fiscal year 2003 and is projected to be complete in fiscal year 2014. Other critical data, including the results of the Air Force Fleet Viability Board assessment of the F-16, robust engineering data related to wing cracks and other structural problems on legacy F-16s, and the results of the F-16 full-scale durability test, were also not available to support a comprehensive cost estimate. Information received after the Air Force reports were issued, indicating that the wings on older F-16s are in better condition than originally anticipated, has led service officials to change their assumptions, and they now believe that the near-term shortfall that had been projected to begin as soon as 2012 has been mitigated.

Air Force Fleet Viability Board assessments of both older and newer F-16s were not yet available at the time the Air Force did its analyses. The Fleet Viability Board provides an integrated analysis of a fleet's technical fitness, associated aircraft availability, and cost of continued ownership for specific aircraft. This analysis provides Air Force senior leadership with information on a range of topics relevant to the continued viability of a specific aircraft fleet, including potential costs, benefits and risks of the best options. The assessments cover various time frames, expected supportability and sustainability issues, and the relative utility of offensive and defensive aircraft systems and avionics. They are a valuable source of planning and investment information.

The Air Force's assumptions about the need to invest in its older F-16s have now changed. At the time the reports were issued, Air Force data projections indicated that many of the older F-16 aircraft were going to encounter wing cracks and other structural problems that would require them to be retired early if no corrective action was taken. As a result, the Air Force anticipated that the fighter shortfall would begin in the near term unless the problems were addressed. However, as more data have become available through examining legacy aircraft wings during routine maintenance actions, Air Force officials have revised their projections and now believe that the wing cracking problem is not as severe as originally projected. As a result, they believe that the near-term fighter shortfall has been mitigated without an additional investment. The new wing crack data, however, have not yet been officially validated by the Fleet Viability Board. The Viability Board's final assessment of the older F-16 fleet is expected to be released to Air Force senior leadership in February 2011.

The Air Force conclusion that the service lives of the newer F-16 aircraft could be extended by 4 to 5 years, and that their capabilities could be upgraded to help mitigate the projected fighter shortfall, was not informed by a Fleet Viability Board assessment or key durability test results. The Viability Board's assessment of the newer F-16 fleet is expected to be delivered to Air Force senior leadership around June 2011. The full-scale durability test for the newer F-16s is expected to begin sometime in 2011. According to service officials the test will take approximately 3 years from setup to reporting, although data will be reported throughout the duration of the test. The final results of these two assessments are needed in order to gain a definitive understanding of the full cost and technical feasibility of extending the service life and enhancing the capabilities of newer F-16 aircraft. The Air Force has

not yet determined the exact number of newer F-16s that it will modernize and upgrade, but service officials emphasize that the near-term shortfall has been mitigated by the better than anticipated condition of the older F-16s, so the final number will not have to be determined until they begin developing the fiscal year 2016 budget.

Although F-16 fleet viability analyses and durability testing were not yet complete, the Air Force relied on program office and contractor estimates, along with preliminary warfighting analysis, to conclude that extending the service life and upgrading current F-16 aircraft was a better option than procuring new upgraded aircraft. In large part, this conclusion was based on Air Force calculations that estimated that modernizing and upgrading current F-16s would cost about \$9 million per aircraft and could provide essentially the same capabilities as procuring new upgraded aircraft, but at about 10 to 15 percent the cost. According to service officials, this option would minimize the impact on JSF program funding. The Air Force estimated that the cost of buying new upgraded aircraft could range from roughly \$55 million (F-16) to roughly \$90 million (F-15) per aircraft. However, the Air Force noted that these estimated unit costs were at a rough order of magnitude and could be 20 percent above or 20 percent below the actual costs.

The Air Force's analysis did not reflect the differences in the amount of aircraft service life that each alternative offered. For example, the Air Force estimates that modernizing and upgrading operational F-16s will increase the service life of each aircraft by 2,000 flight hours, while a new aircraft would provide at least 8,000 flight hours. Using the Air Force's \$9 million per aircraft estimate, we calculate the cost to modernize and upgrade newer F-16s would be about \$4,500 per additional flight hour, while procuring new F-16s would cost \$6,875 per additional flight hour. Viewed from this perspective the percentage difference between the two options would be smaller.<sup>9</sup> We also note that F-15 and F-16 aircraft are currently in production for foreign militaries, while key analyses and durability testing for the F-16 service-life extension have not yet been completed by the Air Force. Although procuring new F-15 or F-16 aircraft would likely require some research and development investment, the procurement costs, schedule and risks of acquiring them may be more reliably predicted at this time than extending service lives of operational F-16s. However, as previously mentioned, Air Force officials have concluded that procuring new upgraded legacy aircraft is undesirable largely because they would not provide 5th generation capability, the upfront acquisition cost would likely divert funding from JSF procurement, and the Air Force does not believe that new upgraded legacy aircraft would be supportable or effective over the long term.

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<sup>9</sup> The cost per flight hour figures only reflect the Air Force's estimated acquisition costs. Operation, support, and disposal costs were unavailable and are not included. Our analysis was done using data from the Air Force's estimate of acquisition costs and assumptions regarding flight hours. The analysis is only intended to illustrate perspectives that could have been highlighted if different analyses had been done, and does not represent a rigorous, comprehensive cost estimate by GAO.


## Agency Comments

DOD reviewed a draft of this report, but had no formal written comments. DOD did, however, provide technical comments, which we incorporated as appropriate.

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A handwritten signature in black ink, appearing to read 'Michael J. Sullivan', with a stylized, flowing script.

Michael J. Sullivan, Director  
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*Defense Acquisitions: Assessments of Selected Weapon Programs.* [GAO-10-388SP](#). Washington, D.C.: March 30, 2010.

*Joint Strike Fighter: Additional Costs and Delays Risk Not Meeting Warfighter Requirements on Time.* [GAO-10-382](#). Washington, D.C.: March 19, 2010.

*Joint Strike Fighter: Significant Challenges Remain as DOD Restructures Program.* [GAO-10-520T](#). Washington, D.C.: March 11, 2010.

*Joint Strike Fighter: Strong Risk Management Essential as Program Enters Most Challenging Phase.* [GAO-09-711T](#). Washington, D.C.: May 20, 2009.

*Joint Strike Fighter: Accelerating Procurement before Completing Development Increases the Government's Financial Risk.* [GAO-09-303](#). Washington D.C.: March 12, 2009.

*Homeland Defense: Actions Needed to Improve Management of Air Sovereignty Alert Operations to Protect U.S. Airspace.* [GAO-09-184](#). Washington, D.C.: Jan. 27, 2009.

*Defense Acquisitions: Better Weapon Program Outcomes Require Discipline, Accountability, and Fundamental Changes in the Acquisition Environment.* [GAO-08-782T](#). Washington, D.C.: June 3, 2008.

*Joint Strike Fighter: Recent Decisions by DOD Add to Program Risks.* [GAO-08-388](#). Washington, D.C.: March 11, 2008.

*Tactical Aircraft: DOD Needs a Joint and Integrated Investment Strategy.* [GAO-07-415](#). Washington, D.C.: April 2, 2007.

*Tactical Aircraft: Recapitalization Goals Are Not Supported by Knowledge-Based F-22A and JSF Business Cases.* [GAO-06-487T](#). Washington, D.C.: March 16, 2006.

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